

<b>Interview Summary</b>	Application No. 09/993,531	Applicant(s) TODD, KEVIN B.	
	Examiner Bradley J. Van Pelt	Art Unit 3682	

All participants (applicant, applicant's representative, PTO personnel):

- (1) Bradley J. Van Pelt. (3) Kevin Todd.  
 (2) Tim Levstik. (4) \_\_\_\_\_.

Date of Interview: 22 June 2005.

Type: a) ☐ Telephonic b) ☐ Video Conference  
 c) ☒ Personal [copy given to: 1) ☐ applicant 2) ☒ applicant's representative]

Exhibit shown or demonstration conducted: d) ☐ Yes e) ☐ No.  
 If Yes, brief description: \_\_\_\_\_.

Claim(s) discussed: 1-31 and 33-48.

Identification of prior art discussed: Ledvina '943.

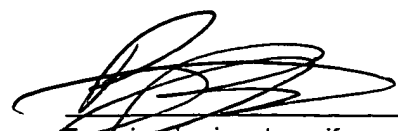
Agreement with respect to the claims f) ☐ was reached. g) ☐ was not reached. h) ☒ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: The examiner indicated that the proposed claims (see attachment) overcome the immediate prior art of record. The examiner suggested that claim 20, lines 7 and 8 "which will repeat" be changed to --which repeats--, and claim 33, line 13, "third pitch radius, the pitch radii" be changed to --third pitch radius, each of the pitch radii--.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

  
 \_\_\_\_\_  
 Examiner's signature, if required

## Summary of Record of Interview Requirements

### Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

### Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

#### Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

#### 37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,  
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

### Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

**FITCH, EVEN, TABIN & FLANNERY**

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DATE: June 21, 2005

NO. OF PAGES: Cover + 19

FROM: James P. Krueger

DISPATCHED BY: Molly

Re:

OUR FILE NO.: 70723

TO: Name: Examiner Bradley Van Pelt, Group Art Unit 3682  
Company/Firm: USPTO  
City/State/Country: Alexandria, VA  
Facsimile No.: 571.273.7113

## MESSAGE:

*Attached please find a draft Amendment for your interview with Tim Levstik on June 22, 2005 @ 10:00 am.*

The documents accompanying this facsimile transmittal cover sheet contain information from the law firm of Fitch, Even, Tabin & Flannery which may be confidential and/or legally privileged. The documents are intended only for the personal and confidential use of the addressee identified above. If you are not the intended recipient or an agent responsible for delivering these documents to the intended recipient, you are hereby notified that any review, disclosure, copying, distribution or the taking of any action in reliance on the contents of this transmitted information is strictly prohibited. If you have received this facsimile in error, please immediately notify the Firm so that we can arrange for the return of the original documents to us. Thank you.

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE****DRAFT**

Appln No.: 09/993,531	)	Confirmation No. 9261
Filed: November 6, 2001	)	
Applicant(s): Todd	)	<u>CERTIFICATE OF MAILING</u>
Title: TENSION-REDUCING RANDOM SPROCKET	)	I hereby certify that this paper is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to the Commissioner for Patents, P.O Box 1450, Alexandria, VA 22313-1450, on this date.
Art Unit: 3682	)	
Examiner: Bradley Van Pelt	)	
Attorney Docket No.: DKT00151	)	Date Timothy E. Levstik Registration No. 30,192 Attorney for Applicant(s)

**AMENDMENT AND RESPONSE**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

The Applicant respectfully provides this response to the Office action of May 10, 2005.

**Amendments to the Claims** are reflected in the listing of claims which begins on page 2 of this paper.

**Remarks** begin on page 17 of this paper.

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**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

Claim 1 (Currently Amended): A chain and sprocket drive system comprising:

a chain having a plurality of pairs of links being interconnected by pins;

one or more generally circular sprockets which operate at varying speeds and the chain having external tensions imparted to it originating from sources other than the sprocket, the sprockets having a plurality of teeth spaced about their periphery, the sprockets having roots located between pairs of adjacent teeth for receiving the chain pins;

each of the roots having a root radius extending between the center of the sprocket and a point along the root closest to the sprocket center in a radial direction;

at least one of the roots having a first root radius, and at least one of the roots having a second root radius, at least one of the roots having a third root radius, the second root radius being less than the first root radius, the third root radius being less than the second root radius; and

the first, ~~and second~~, and third root radii arranged in a pattern which repeats around the periphery of the sprocket, the repeating pattern effective to redistribute the external tensions imparted to the chain, reducing maximum tension forces exerted on the chain during operation of the system relative to the maximum tension forces in the system where the sprocket is a straight sprocket.

1st rd  
2nd rd  
3rd  
  
2 < 1  
3 < 2

Claim 2 (Currently Amended): The chain and sprocket system according to Claim 1, wherein the pattern substantially repeats three times ~~sprocket operates at varying speeds~~

~~and the chain tensions are redistributed to sprocket orders effective to reduce the maximum tension forces imparted to the chain during rotation of the sprocket.~~

Claim 3 (Original): The chain and sprocket system according to Claim 2 wherein the root radii are arranged in a major pattern and a minor pattern.

Claim 4 (Original): The chain and sprocket drive system according to Claim 3, wherein the tensions are redistributed to have concentrated tensions at least at four times for every rotation of the sprocket.

Claim 5 (Previously Presented): The chain and sprocket system according to Claim 1 wherein the root radii are arranged in a pattern that also reduces noise produced by the interaction of said chain and said sprocket.

~~Claim 6 (Cancel): The chain and sprocket drive system according to Claim 1 wherein external tensions are imparted to the chain from sources other than the sprocket, and the sprocket is provided with a root radii pattern effective to offset the external tensions in the chain reducing maximum tension forces exerted on the chain relative to maximum tension forces in the system where the sprocket is a straight sprocket.~~

~~Claim 7 (Cancel): The chain and sprocket drive system according to Claim 1, wherein external tensions are imparted to the chain from sources other than the sprocket, and the sprocket is provided with a root radii pattern effective to increase the overall tensions exerted on the chain.~~

Claim 8 (Cancel): The chain and sprocket drive system according to Claim 1, wherein at least one of the roots has a third root radius, the third root radius being less than the second root radius.

Claim 9 (Cancel): The chain and sprocket drive system according to Claim 8, wherein the first, second, and third root radii are arranged in a pattern that substantially repeats four times around the sprocket.

Claim 10 (Currently Amended): A sprocket comprising:

a plurality of teeth disposed along a circumference of the sprocket, adjacent teeth having roots therebetween, each of the roots having a root radius defined as the distance between the center of the sprocket and a point along the root closest to the sprocket center in a radial direction, the sprocket teeth and roots disposed to receive and engage a circular loop of chain which operates at variable speeds; and

<sup>3</sup>  
a plurality of different at least three different root radii, including a first root radius, a second root radius and a third root radius, the second radius less than the first and the third less than the second,

the at least three different root radii arranged in a pattern which repeats around the sprocket for distributing the tensions imparted to the chain by the sprocket to one or more preselected orders relative to the rotation of the sprocket, the distributed tensions effective to offset tensions imparted to the chain <sup>112?</sup> by forces external to the sprocket ~~other tension sources~~ reducing maximum tension forces exerted on the chain relative to maximum tension forces in the system where the sprocket is a straight sprocket.

Claim 11 (Original): The sprocket according to Claim 10 wherein the root radii are arranged in a plurality of patterns, at least one of which is major pattern and at least one of which is a minor pattern.

Claim 12 (Original): The sprocket according to Claim 10 wherein the pattern of root radii also is effective to reduce the noise generated by the interaction of the sprocket and a chain.

Claim 13 (Previously Presented): The sprocket according to Claim 10 wherein a preselected order comprises a fourth order.

Claim 14 (Cancel): The sprocket according to Claim 10 wherein external tensions from sources other than the sprocket are imparted to the chain, and one or more of the preselected sprocket orders and the tensions distributed thereto are chosen to correspond to peaks in the external tensions effective to at least partially offset the external tensions imparted to the chain.

Claim 15 (Currently Amended): The sprocket according to Claim 10 wherein the pattern repeats three times ~~external tensions from sources other than the sprocket are imparted to the chain, and one or more of the preselected sprocket orders are chosen to add to the external tensions in the chain.~~

Claim 16 (Cancel): The sprocket according to Claim 10 wherein the plurality of



different root radii comprises at least a first root radii and a second root radii being less than the first root radii.

Claim 17 (Currently Amended): The sprocket according to Claim 16 wherein the ~~first and second root radii are arranged in a pattern that~~ substantially repeats four times around the sprocket.

Claim 18 (Cancel): The sprocket according to Claim 16 wherein the plurality of different root radii comprise a third root radii being less than the second root radii.

Claim 19 (Cancel): The sprocket according to Claim 18 wherein the first, second, and third root radii are arranged in a pattern that substantially repeats four times around the sprocket.

Claim 20 (Currently Amended): A method of distributing tensions imparted to a chain and sprocket system operating at variable speeds, the method comprising:

providing a sprocket having a plurality of teeth separated by roots;

providing each root with a root radius extending between the center of the sprocket and a point along the root closest to the sprocket center in a radial direction;

providing at least three a plurality of different root radii; and

arranging the different root radii between adjacent sprocket teeth in a pattern which will repeat at least two times effective to distribute for distributing the tensions imparted to the chain and sprocket system reducing maximum tension forces exerted on the chain relative to maximum tension forces in the system where the sprocket is a straight sprocket.

Claim 21 (Currently Amended): The method according to Claim 20, wherein the pattern repeats three times ~~comprising selecting a root radii pattern effective to concentrate chain tensions at one or more predetermined sprocket orders.~~

Claim 22 (Currently Amended): The method according to Claim 20 ~~24~~ wherein a plurality of root radii patterns are selected, at least one a major pattern and at least one a minor pattern.

Claim 23 (Currently Amended): A method according to Claim 20 ~~24~~ comprising selecting the root radii pattern effective also to reduce the noise generated by the interaction of the chain with the sprocket.

Claim 24 (Original): The method according to Claim 20, comprising concentrating the tensions imparted to the chain by the sprocket at a fourth sprocket order.

Claim 25 (Original): The method according to Claim 20, comprising selecting the root radii pattern effective to at least partially offset tensions imparted to the chain by sources other than the sprocket to balance the overall tension force imparted to the system by all tension sources.

Claim 26 (Original): A method of concentrating tensions according to Claim 20, comprising selecting the root radii pattern effective to at least partially add to tensions imparted to the chain by sources other than the sprocket to at least partially balance the overall tension force imparted to the system by all tension sources.

~~Claim 27 (Cancel): A chain and sprocket system adapted for reducing chain tensions in the system, the sprocket comprising:~~

~~means for concentrating the tensions imparted to the chain by the sprocket at one or more predetermined sprocket orders; and~~

~~means for at least partially offsetting tensions imparted to the chain by sources other than the sprocket and reducing maximum tension forces exerted on the chain relative to the maximum tension forces in the system where the sprocket is a straight sprocket.~~

~~Claim 28 (Cancel): The sprocket according to Claim 27, wherein the predetermined sprocket order is at least a fourth order.~~

Claim 29 (Currently Amended): An automotive timing system comprising:

a chain which operates at variable speeds, the chain having a plurality of pairs of links being interconnected by pins; and

a generally circular sprocket mounted on a cam shaft having a plurality of teeth spaced about the periphery, the sprocket having roots located between pairs of adjacent teeth for receiving the chain pins; ,

each of the roots having a root radius extending between the center of the sprocket and a point along the root closest to the sprocket center in a radial direction; ,

at least one of the roots having a first root radius, at least one of the roots having a second root radius, and at least one of the roots having a third root radius, the second root radius being less than the first root radius and the third root radius being less than the second root radius; and

the first, second, and third root radii arranged in a pattern which repeats at least two times and which maintains maintaining the distance between the chain pins substantially constant while the chain is engaged around the sprocket and effective to redistribute tensions imparted to the chain reducing maximum tension forces exerted on the chain during operation of the system.

Claim 30 (Original): The automotive timing system according to claim 29, wherein the pattern comprises a sequence of second, third, third, second, first, second, third, third, second, first, second, third, third, second, first, second, third, third, and second root radii.

Claim 31 (Currently Amended): The automotive timing system according to Claim 29 24 wherein the root radii pattern is effective also to reduce the noise generated by the interaction of the chain and the sprocket.

~~Claim 32 (Cancel): A sprocket comprising:  
a plurality of teeth disposed along a circumference of the sprocket, adjacent teeth being adapted for contacting teeth of a silent chain, the sprocket having a pitch radius defined as the distance from the center of the sprocket to a center of a joint of the silent chain when a tooth of the silent chain proximate the joint is seated between adjacent teeth of the sprocket; and~~

a plurality of pitch radii arranged in a pattern effective to distribute the tensions imparted to the silent chain at one or more preselected orders relative to the rotation of the sprocket.

**Claim 33** (Currently Amended): An automotive drive system comprising:

a chain subject to tension loading sources external to the drive chain, the chain having a plurality of links, each link formed of two or more plates interconnected by pins, each pin having a central longitudinal axis, and the links providing contact surfaces;

the chain traveling in a loop about at least one sprocket in driving engagement with the chain and at least one sprocket in driven engagement with the chain, each sprocket having a central axis of rotation and plurality of surfaces spaced about the periphery of the sprocket disposed to engage the chain link contact surfaces;

the sprocket engagement surfaces spaced a distance from the sprocket central axis to position the chain at a pitch radius defined by the distance between the sprocket central axis and the pin axis of a chain link engaged by the surfaces; and

the engagement surfaces of at least one of the sprockets disposed to engage the chain at least at a first pitch radius, ~~and at least at a second pitch radius, and at least a third pitch radius,~~ <sup>each of said pitch radii</sup> the pitch radii being different, repeating with each rotation of the sprocket and arranged in a pattern imparting tensions to the chain at one or more sprocket orders effective to reduce maximum chain tensions during operation of the system relative to maximum chain tensions of the system where the sprocket is a straight sprocket.

Claim 34 (Previously Presented): The automotive drive system of Claim 33 wherein the system operates at variable speeds, the system speeds where chain tensions are generally at a maximum are the system resonance conditions; and the pattern of pitch radii are arranged to impart a maximum tension to the chain at said system resonance speeds.

Claim 35 (Currently Amended): The automotive drive system of Claim 34 wherein the first pitch radius is greater than the second pitch radius and the second pitch radius is larger than the third pitch radius ~~repeats in a regular pattern during the rotation of the sprocket and the second pitch radius repeats in a regular pattern during the rotation of the sprocket, the first radius spaced from the second radius with other pitch radii therebetween.~~

Claim 36 (Currently Amended): The automotive drive system of Claim 35 wherein the engagement surfaces of each tension reducing sprocket ~~provide a repeating pattern~~ repeats at least twice with each rotation of the sprocket of pitch radii having a first, minimum pitch radius, a plurality of pitch radii increasing to a second, maximum pitch radius, and a plurality of radii decreasing to the minimum pitch radius.

~~Claim 37 (Cancel): The automotive drive system of Claim 33 wherein the engagement surfaces of the tension reducing sprocket are disposed to provide a repeating, regular pattern at least three times with each rotation of the sprocket of pitch radii effective to reduce the maximum chain tensions during operation of the system relative to a system where the sprocket engagement surfaces are disposed to provide an irregular pattern of pitch radii.~~

Claim 38 (Previously Presented): The automotive drive system of Claim 33 wherein the driving sprocket is rotated by an automotive powerplant at varying speeds; the powerplant operating at one or more speeds that produce substantially maximum chain tensions; and the pitch radii patterns of the tension reducing sprockets are effective to reduce said maximum chain tensions relative to maximum chain tensions in a system where the sprocket is a straight sprocket.

Claim 39 (Previously Presented): The automotive drive system of Claim 38 wherein the pitch radii pattern provided by each tension reducing sprocket is effective to produce a maximum chain tension that is substantially equal to or less than the chain tension in a system where the sprocket is a straight sprocket through the normal operating speed range of the powerplant.

Claim 40 (Currently Amended): An automotive drive system operable at variable speeds comprising:

a chain subject to tension loads traveling in a loop about at least one sprocket in driving engagement with the chain;

and at least one sprocket in driven engagement with the chain, the system operating at one or more speeds where chain tensions reach a peak relative to chain tensions at other system speeds, the system having tensions imparted from sources other than the chain and sprocket;

the chain having a plurality of links formed of two or more plates interconnected by pins, each pin having a central longitudinal axis and the links providing chain contact surfaces,

the at least one each sprocket having a central axis of rotation and a plurality of teeth and sprocket engagement surfaces between the teeth, surfaces

the teeth and the sprocket engagement surfaces spaced about the their periphery of the sprocket, the sprocket engagement surfaces disposed to engage the chain link contact surfaces;

the sprocket engagement surfaces spaced a distance from the sprocket central axis to dispose the chain at a pitch radius defined by the distance between the sprocket central axis and the pin axis of a chain link engaged by the surfaces; and

the engagement surfaces of at least one of the sprockets disposed to engage the chain to provide a pattern of at a minimum pitch radius, a maximum pitch radius, and intermediate pitch radii therebetween,

the engagement surfaces maintaining the distance between adjacent pin axes of links engaged with the sprocket substantially constant, and

the pitch radii ~~in a pattern~~ being repeated at least twice with each rotation of the sprocket for imparting tensions to the chain timed with respect to tension loads imparted to the system from other sources effective to reduce maximum chain tensions at one or more of the peak tension speeds relative to the maximum chain tensions at said peak tension speeds where the sprocket is a straight sprocket.

Claim 41 (Currently Amended): The automotive system of Claim 40 wherein the pattern repeats at least two times with each rotation of the sprocket ~~each tension reducing sprocket engagement surfaces provide a regular, repeating pattern of minimum and maximum pitch radii around the sprocket.~~



Claim 42 (Currently Amended): The automotive system of Claim 41 wherein the pattern repeats at least three times with each rotation of the sprocket ~~each tension reducing sprocket engagement surfaces provide a pitch radii pattern where the intermediate pitch radii increase from the minimum pitch radius to the maximum pitch radius and then decrease from the maximum pitch radius to the minimum pitch radius.~~

Claim 43 (Previously Presented): The automotive system of Claim 42 wherein an automotive power plant rotates the driving sprocket, the automotive power plant imparting periodic tension loads on the chain, the system reaching resonance conditions at powerplant speeds where the chain tensions reach their approximate maximum, and the pattern of pitch radii and the timing of the tensions provided by the pitch radii relative to the power plant tension loads are effective to reduce maximum chain tensions during operation of the system at said resonance conditions relative to the system where the sprocket is a straight sprocket operating at resonance conditions.

Claim 44 (Currently Amended): The automotive system, of Claim 43 42 wherein the pattern repeats at least three times with each rotation of the sprocket ~~one or more cam sprockets imparts periodic tension loads on the chain, the system reaching resonance conditions at powerplant speeds where chain tensions are at their approximate maximum, and the pattern of pitch radii and the timing of the tensions provided by the pitch radii is effective to reduce maximum chain tension during operation of the system at resonance conditions relative to the system where the sprocket is a straight sprocket operated at resonance conditions.~~

Claim 45 (Currently Amended): A tension reducing sprocket for an automotive drive system having a continuous loop chain in driving engagement with a driving sprocket and a driven sprocket, the chain formed of two or more plates interconnected by pins, each pin having a central longitudinal axis, and the links providing contact surfaces disposed to engage the sprocket, the sprocket comprising:

a sprocket body and a central rotational axis, the sprocket body provided with engagement surfaces about its periphery, the engagement surfaces disposed to receive the chain link contact surfaces in a driving relation, the engagement surfaces spaced a distance from the sprocket central axis to position the chain link received thereon at a pitch radius defined by the distance between the sprocket central axis and the chain link pin axis; and

the engagement surfaces providing a repeating pattern of at least three different pitch radii which repeats with each rotation of the sprocket ~~a first pitch radius, and at least a second greater pitch radius~~, the pattern of the pitch radii effective to reduce maximum chain tensions during operation of the drive system relative to the system where the sprocket is a straight sprocket.

Claim 46 (Previously Presented): The tension reducing sprocket of Claim 45 wherein at least the first and second pitch radii are selected and disposed to impose tension events on the chain timed with respect to torque loads imposed on the chain from other sources effective to reduce the maximum chain tensions during operation of the drive system relative to a system where the sprocket is a straight sprocket.

Claim 47 (Previously Presented): The tension reducing sprocket of Claim 46

wherein the first pitch radius repeats in a regular pattern during the rotation of the sprocket and the second pitch radius repeats in a regular pattern during the rotation of the sprocket, the first radius spaced from the second radius with other pitch radii therebetween.

Claim 48 (Previously Presented): The tension reducing sprocket of Claim 45 wherein the engagement surfaces of the tension reducing sprocket are disposed to provide a repeating pattern of pitch radii having a minimum pitch radius, a plurality of pitch radii increasing to a maximum pitch radius, and a plurality radii decreasing to the minimum pitch radius.

Claim 49 (New) this is claims 1, 8 and 9: A chain and sprocket drive system comprising:

- a chain having a plurality of pairs of links being interconnected by pins;
- one or more generally circular sprockets having a plurality of teeth spaced about their periphery, the sprocket having roots located between pairs of adjacent teeth for receiving the chain pins;
- each of the roots having a root radius extending between the center of the sprocket and a point along the root closest to the sprocket center in a radial direction;
- at least one of the roots having a first root radius, and at least one of the roots having a second root radius, at least one of the roots having a third root radius, the second root radius being less than the first root radius, the third root radius being less than the second root radius; and
- the first, second and third root radii arranged in a pattern that substantially repeats four times around the sprocket, the pattern effective to redistribute tensions imparted to the

chain, reducing maximum tension forces exerted on the chain during operation of the system relative to the maximum tension forces in the system where the sprocket is a straight sprocket.

Claim 50 (New)- this is claims 10, 16, 18, and 19 A sprocket comprising:

a plurality of teeth disposed along a circumference of the sprocket, adjacent teeth having roots therebetween, each of the roots having a root radius defined as the distance between the center of the sprocket and a point along the root closest to the sprocket center in a radial direction, the sprocket teeth and roots disposed to receive and engage a circular loop of chain; and

at least three different root radii, the second radius being less than the first radius and the third radius being less than the second radius, the at least three different root radii arranged in a pattern around the sprocket that substantially repeats four times around the sprocket arranged in a pattern distributing the tensions imparted to the chain by the sprocket to one or more preselected orders relative to the rotation of the sprocket, the distributed tensions effective to offset tensions imparted to the chain by other tension sources reducing maximum tension forces exerted on the chain relative to maximum tension forces in the system where the sprocket is a straight sprocket.

Claim 51 (New) this is claims 29 and 30 An automotive timing system comprising:

a chain having a plurality of pairs of links being interconnected by pins; and

a generally circular sprocket mounted on a cam shaft having a plurality of teeth spaced about the periphery, the sprocket having roots located between pairs of adjacent teeth for receiving the chain pins,

each of the roots having a root radius extending between the center of the sprocket and a point along the root closest to the sprocket center in a radial direction,

at least one of the roots having a first root radius, at least one of the roots having a second root radius, and at least one of the roots having a third root radius, the second root radius being less than the first root radius and the third root radius being less than the second root radius, and

the first, second, and third root radii arranged in a pattern comprising a sequence of second, third, third, second, first, second, third, third, second, first, second, third, third, second, first, second, third, third, and second root radii, the pattern maintaining the distance between the chain pins substantially constant while the chain is engaged around the sprocket and effective to redistribute tensions imparted to the chain and reduce reducing maximum tension forces exerted on the chain during operation of the system.

Claim 52 (New): The automotive timing system according to claim 29, wherein the pattern comprises a sequence of second, third, third, second, first, second, third, third, second, first, second, third, third, second, first, second, third, third, and second root radii.

Claim 53 (New): The method according to claim 20 wherein the pattern repeats four times.

**REMARKS**

Claims 1- are pending upon entry of this Amendment and Response; claim 32 was previously withdrawn, and claims 48-53 are new.

Claims 1-8, 10-18 and 20-28 stand rejected under 35 U.S.C. 102(b) in view of U.S. Patent No. 4,526,558 to Durham. Claims 29 and 31 stand rejected under 35 U.S.C. 103 over U. S. Patent No. 5,876,295 to Young in view of U.S. Patent No. 4,526,558 to Durham.

For the reasons set forth above, Applicant submits that Claims 1-31 and 33-48 are in condition for allowance.

Respectfully submitted,  
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